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The enigmatic Pennsylvanian arachnids *Areomartus ovatus* and *Vratislavia silesica* (Trigonotarbida)

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Abstract. *Areomartus ovatus* Petrunkevitch 1913, from the Pennsylvanian (Kanawah Formation; Bashkirian?) of Cotton Hill, Fayette County, West Virginia, USA is redescribed. Originally placed in the family Eophrynidae of the extinct arachnid order Trigonotarbida, it lacks unequivocal eophrynid features. Nevertheless, *Areomartus* Petrunkevitch 1913 was used as the type genus of a now superfluous eophrynid subfamily Areomartinae Petrunkevitch 1955. The present revision suggests that too much emphasis was placed on the primary diagnostic character of *Areomartus*, hexagonal fields across the carapace, in a rather poorly preserved and incomplete specimen. *Areomartus ovatus* is thus removed from Eophrynidae and treated as Trigonotarbida incertae sedis. *Vratislavia silesica* (Römer 1878) from the Pennsylvanian (Langsettian?) of Kłodzko (formally Glatz) in Silesia, Poland is another problematic eophrynid. The holotype is believed lost, and thus interpretations rely on published figures. Opisthosomal morphology suggests that *V. silesica* actually belongs in a different trigonotarbid family: Anthracosironidae.

Keywords: Fossil, Areomartinae, Coal Measures, West Virginia, Silesia

Areomartus ovatus Petrunkevitch 1913 is a poorly known and enigmatic fossil arachnid from the mid-Pennsylvanian Coal Measures of Fayette County, West Virginia, USA. It was briefly described by Petrunkevitch (1913), who placed it in the extinct order Trigonotarbida (then under the older name Anthracomarti) who defined the monotypic genus based on a unique and unusual character: "Cephalothorax triangular, wider than long, its surface divided into hexagonal fields." The specimen is only known from the body (Figs. 1–3) with most of the limbs missing. The original description is rather brief. The accompanying photograph is small and yet there seem to be discrepancies between this and the interpretative drawing, for example in the degree of curvature of the opisthosomal sclerites.

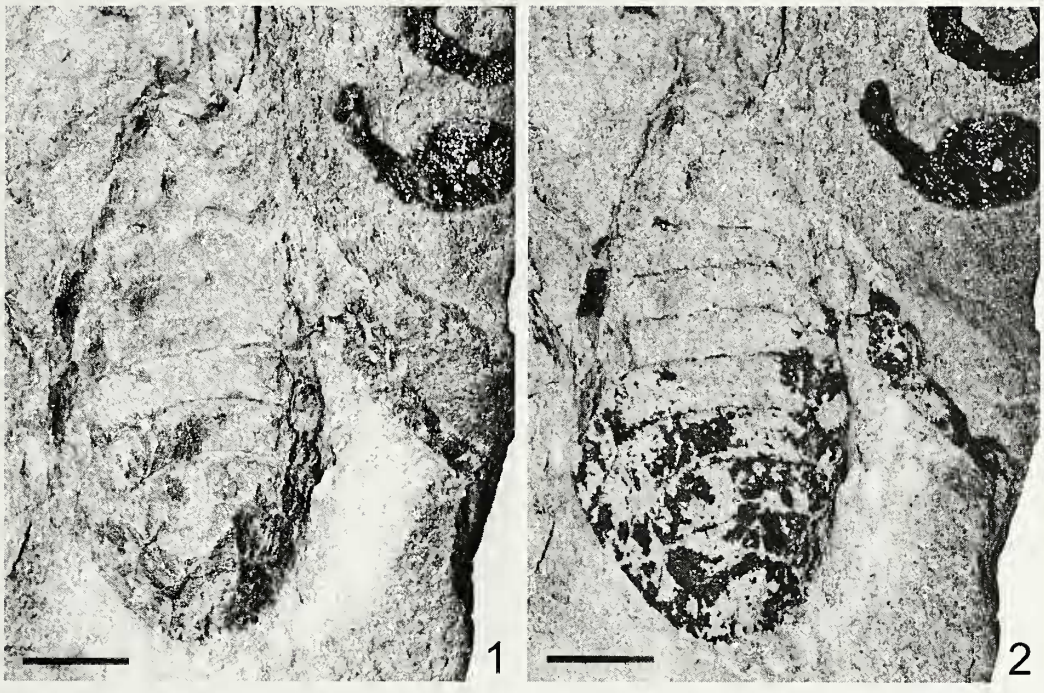
Petrunkevitch (1913) assigned *A. ovatus* to the trigonotarbid family Eophrynidae. This lineage is typically characterized (Pocock 1902; Dunlop 1995; Garwood et al. 2009) by a heavily tuberculate dorsal surface of both the carapace and opisthosoma, the latter usually with four large spines projecting from the posterior margin. At least according to current interpretations, *A. ovatus* differs markedly in having smooth tergites and no posterior spines. As noted above, an irregular ornament of hexagons on the carapace is not known from other eophrynids, or other fossil arachnids in general. Petrunkevitch (1913) commented that the carapace, from which eyes incidentally were not described, seemed unusually small compared to the opisthosoma, which implies that this body region may not be completely preserved. The species was briefly mentioned in several instances by Petrunkevitch (1949, 1953, 1955), by which time the diagnosis of the genus was amended to "Tergites smooth. Carapace triangular, with shallow, hexagonal depressions." (Petrunkevitch 1955) In summary, *A. ovatus* seems to be a rather atypical eophrynid based on the published literature.

Another problematic eophrynid is *Vratislavia silesiaca* (Römer 1878) from the coal measures of Silesia in southwestern Poland. Historically it one of the oldest records of Trigonotarbida, although Römer's original description is extremely brief and referred the fossil to the genus *Architarbus* Scudder 1868, implicitly a member of another extinct arachnid order, Phalangiotarbida. It was correctly identified as a trigonotarbid by Haase (1890), who transferred it to *Anthracomartus* Karsch 1882. Subsequently, Anton Frič raised a new genus, *Vratislavia* Frič 1904, for Römer's fossil. Frič provided the first illustrations of the holotype (Figs. 4, 5), which appears to consist primarily of the (? ventral) opisthosoma and some partial limbs. *Vratislavia* was placed in the family Anthracomartidae, although Petrunkevitch (1913, 1953, 1955) subsequently transferred it to Eophrynidae, making reference in his 1953 monograph to a series of posterior spines on the opisthosoma shown in Frič's illustrations. By this time the holotype could not be traced (see also Material). The figured spination is indeed a typical eophrynid feature, as noted above, but in the absence of a type specimen or photographic documentation their presence in *Vratislavia* relies on the accuracy of Frič's observations. In some cases, these have been found wanting (see, e.g., comments in Pocock 1910), where some trigonotarbids were interpreted by Frič (1904) as spiders because of the supposed presence of opisthosomal spinnerets, structures which could not be confirmed by later observations. Haase (1890) also examined the original specimen of *V. silesiaca*, but made no mention of any spines in his (albeit brief) description.

As part of a planned revision of eophrynids and their relatives, a redescription of *A. ovatus* and a reconsideration of *Vratislavia silesica* are proposed here to confirm whether they even belong in this family and/or preserve sufficient characters for phylogenetic analysis.

METHODS

Material.—The holotype, and only known specimen, of *Areomartus ovatus* was obtained from the United States National Museum, Smithsonian Institution (USNM, No. 60686), Washington D.C., USA. Notes accompanying the specimen imply that it was collected as part of the United States Geological Survey in 1895 by B. Phillips, although one note also states "Lacoe Coll." The repository number was incorrectly stated by Petrunkevitch (1913) as 1196. In fact, this is the locality number and presumably refers to the Cotton Hill type locality. Oddly, a further handwritten label, probably by Petrunkevitch, names the fossil as "*Architarbus ovatus*"; *Architarbus* is, as noted above, a representative of a different



Figures 1, 2.—Holotype and only known specimen of *Areomartus ovatus* Petrunkevitch, 1913 (USNM 1196) (Trigonotarbida incertae sedis) from the Pennsylvanian of West Virginia, USA. 1. Photographed dry under low angle lighting to bring out surface relief. 2. Photographed under 70% alcohol to reveal full segmentation and dark patches of carbonized cuticle. Scale bars = 2 mm.

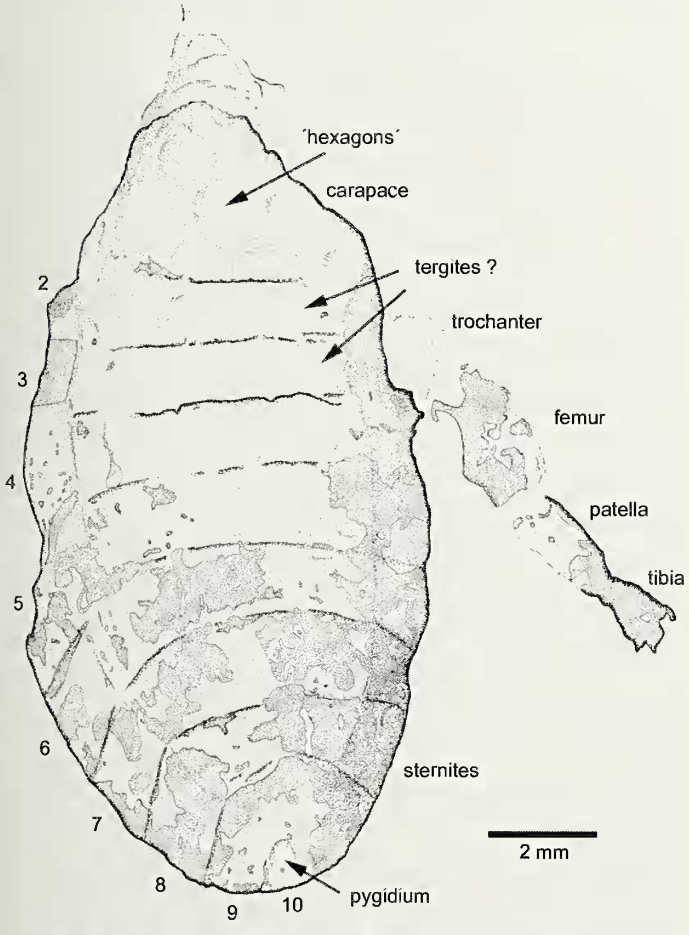
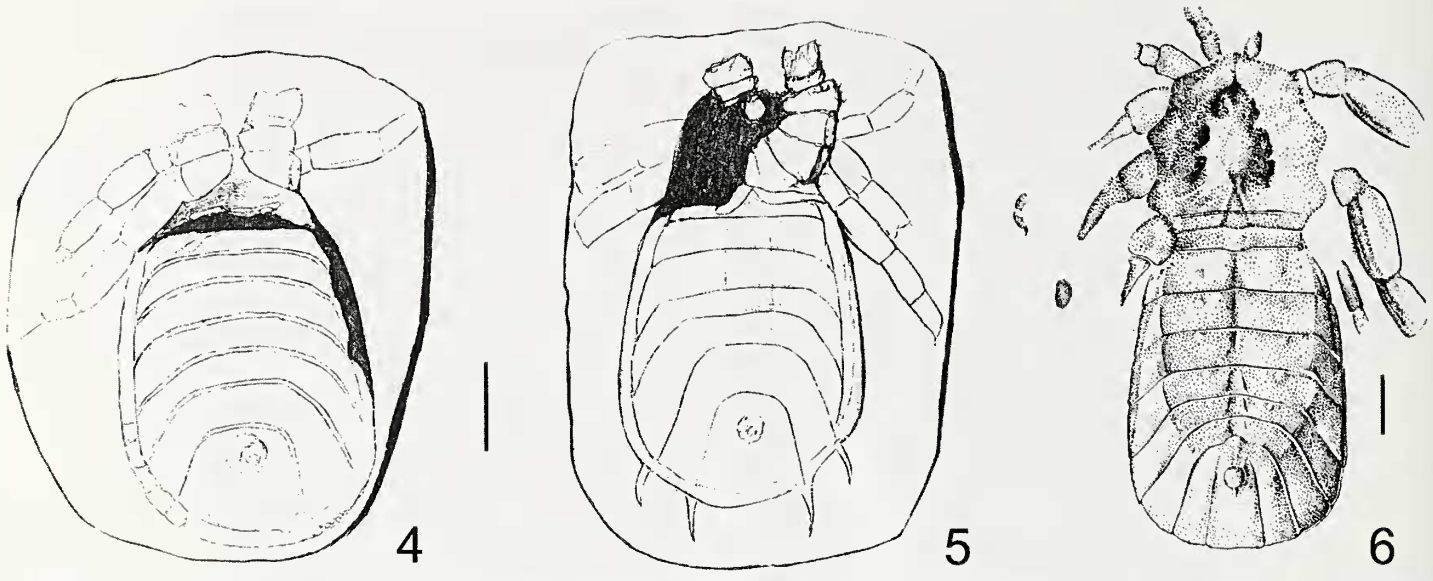


Figure 3.—Camera lucida drawing of the specimen shown in Figs. 1, 2.

extinct order, Phalangiotarbida (= Architarbida in some older literature). The holotype of *Areomartus ovatus* consists of a single specimen, without a counterpart, preserved in a small, quadratic piece of shale about 3 cm across. The reverse side preserves some plant fragments. The specimen was photographed both dry (Fig. 1) and under 70% alcohol (Fig. 2) using a Canon Eos 400 digital camera with a macro lens. It was drawn (Fig. 3) under a Leica MZ12 stereomicroscope with a camera lucida attachment. Images were assembled using Adobe Photoshop©.

The holotype of *Vratislavia silesiaca* originated from the "Ferdinandgrube", near Glatz (now Kłodzko) in the Silesia district of Poland. According to Ferdinand Römer's published notes, it was discovered by Herr Sabarth of Dortmund, a "Markschieder" or mining official responsible for delimiting claims, and passed on to the local mineralogical Museum in Breslau (= Wrocław). Römer personally loaned it from Breslau to Haase in 1890 and the holotype was explicitly cited by Schwarzbach (1935) as being present as Nr. 557 of the Geological Institute Breslau. However, it could no longer be traced by the time of Petrunkevitch's (1953) monograph, or in a more recent search of the most likely repository, the Muzeum Geologiczne (Geological Institute, Wrocław University: Cybulskiego 30, 50–205 Wrocław – A. Pacholska, pers. comm.); see also comments in Dunlop & Rössler (2002) about the fate of another Breslau trigonotarbid specimen.

Age.—Petrunkevitch (1913) gave the stratigraphic horizon of the *A. areomartus* holotype as "lower Kanawha." The Kanawah Formation belongs to the upper part of the Pottsville Formation (e.g., Cardwell et al. 1968). The Kanawah is noted as yielding much of the productive coal deposits in the West Virginia area (see Martino 1996 for a regional overview) as well as numerous plant and animal



Figures 4–6.—Anthracosironidae. 4, 5. *Vratislavia silesiaca* (Römer 1878) from the Pennsylvanian of Silesia, drawings of the (? lost) holotype reproduced from Frič (1904, p. 13, figs. 5, 6); 6. *Anthracosiro woodwardi* Pocock 1903a, dorsal and ventral opisthosomal features partially superimposed, from the more or less contemporary British Middle Coal Measures; reproduced from Pocock (1911, fig. 36). Note particularly the similar curvature of the posterior opisthosomal segments. Scale bars ca 2 mm, based on the described body lengths in the original publications.

fossils from the Coal Measures. The Kanawah Formation spans a time range of ca. 305–317 mya, and thus corresponds roughly to the late Bashkirian and early Moscovian stages in international stratigraphic terms, approximately equivalent to the Namurian and Westphalian stages of European terminology. A precise stratigraphic position for *A. ovatus* is not available either in the original description or the notes accompanying the specimen, but a Bashkirian age is tentatively adopted here.

No published details are available of the horizon yielding *V. silesica*. In his summary of the Silesian fossil arachnids, Schwarzbach (1935) wrote: "Ferdinandgrube bei Glatz (jedenfalls [in any case] Hausdorf b. Neurode). Oberkarbon". This suggests that the Ferdinandgrube is equivalent to an adjacent fossil site, Neurode (= Nowa Ruda). According to Dunlop & Rössler (2002), arachnid-yielding horizons here belong to the Langsettian (Bashkirian) substage (ca 313 mya) within the Silesian Intra-Sudeic Basin [see Bossowski et al. (1995) for a regional overview]. In the absence of any further details, I have adopted a Langsettian (= Westphalian A in European terminology) age here.

SYSTEMATIC PALAEONTOLOGY

Order Trigonotarbida Petrunkevitch 1949
Trigonotarbida incertae sedis
Areomartus Petrunkevitch 1913

Type species.—*Areomartus ovatus* Petrunkevitch 1913 by original designation. No further species known.

Areomartus ovatus Petrunkevitch 1913
Figs. 1–3

Areomartus ovatus Petrunkevitch 1913:102, pl. X, fig. 58, text-fig. 59; Petrunkevitch 1949:259–250, Fig. 123; Petrunkevitch 1953:86; Petrunkevitch 1955:109, fig. 73(2).

Material examined.—USA: *West Virginia*: Holotype, Cotton Hill, Fayette County, B. Phillips, Pennsylvanian, lower Kanawah Formation (= Bashkirian?) [USNM 6068 (part only)].

Description.—Incomplete arachnid; total preserved length 11.5 mm, maximum width 4.8 mm. Outline torpedo-shaped, apparently more pointed anteriorly, but unclear whether entire carapace region is preserved. Putative carapace region triangular, length 3.5 mm, basal width 3.8 mm. Eyes equivocal, but carapace bears ca. nine (sub)hexagonal fields up to about 0.7 mm across. Similar fields appear to continue over the next two segments. Differentiation into dorsal tergites and ventral sternites indistinct (see Remarks), thus measurements (in mm) simply given for visible segments along their midline: 2, 0.8; 3, 0.8; 4, 0.8; 5, 0.9; 6, 0.9; 7, 1.2; 8, 0.6; 9, 1.0. Segments provisionally numbered in comparison to better preserved trigonotarbids and become increasingly strongly curved posteriorly; ninth and tenth segment surrounding a small, circular pygidium, diameter ca 0.3 mm. Tuberculation or other opisthosomal ornament not apparent, but division into median and lateral plates implicit. Isolated limb, probably leg IV, preserved on right side. Demarcation of individual articles indistinct, but approximate article lengths in mm: trochanter, 1.2; femur, 2.0; patella, 1.3; tibia (probably incomplete), 1.0. More distal articles and other appendages equivocal.

Remarks.—The holotype of *Areomartus ovatus* is not especially well-preserved. Despite the torpedo-shaped body, which is often seen in Phalangiotarbida, the distribution of its segments does not correspond to a typical phalangiotarbid arrangement (c.f. figures in Pocock 1911; Petrunkevitch 1913) in which there tends to be a shortening of the anterior opisthosomal segments. The provisional assignment of the holotype to '*Architarbus*' on one of the specimen labels can thus be rejected and *Areomartus ovatus* does appear to be a bone fide trigonotarbid, with the typical round pygidium

towards the back of the opisthosoma. Petrunkevitch (1913) assumed a fossil primarily in dorsal view, but interpreting its segmentation is not easy. The strong curvature of the sclerites, at least towards the posterior of the speeimen around the (ventral) pygidium, is far more consistent with sternites than tergites. Nevertheless there are hints of a division into median and lateral plates, which are typical for trigonotarbid tergites. Dorsal and ventral elements may in fact be to some degree superimposed and a subtle change in the way the sclerites overlap each other was noted in the present study between segments 3 and 4 (Fig. 3). Conceivably, the anterior third represents purely dorsal features and the posterior two-thirds primarily ventral features.

What of the triangular carapace and its putatively diagnostic hexagons? These structures are indeed present, and are best seen under low angle lighting (Fig. 1). However, Petrunkevitch (1913, fig. 59) does seem to have overemphasized both their symmetry and regularity, and his original drawing does not indicate the fact that similar depressions continue, albeit weakly, onto the succeeding sclerites (Fig. 3). Whether they are biological or taphonomic features is hard to tell, but the latter option is perhaps more likely. Overall, the torpedo-like shape and proportions of the fossil would probably allow the species to be recognized again. *Areomartus ovatus* is not a *nomen dubium*, but it preserves no convincing apomorphies of Eophrynidae, or any other trigonotarbid family. Given these uncertainties about many of its morphological details, the species is treated here as Trigonotarbida incertae sedis.

Petrunkevitch (1955) divided Eophrynidae into two subfamilies: Areomartinae, defined by smooth or granular tergites, and Eophryninae, defined by tergites with conspicuous rows of tubercles. Defining a taxon on a variable character state (i.e. a smooth or granular dorsal surface) is problematic. In any case, Rössler & Dunlop (1997) resurrected Haase's (1890) family Kreischeriidae for the more 'granular' eophrynids. Since Kreischeriidae now accommodates most of the areomartine genera sensu Petrunkevitch, and since *Areomartus* itself has been removed here from Eophrynidae, a subfamily based around this genus becomes superfluous and should be abandoned. Any remaining eophrynid taxa with 'smooth' tergites (see e.g., *Vratislavia* below) are probably misplaced at the family level.

Family Anthracosironidae Pocock 1903b
Vratislavia Frič 1904

Type species.—*Architarbus silesiacus* Römer 1878 by monotypy. No further species known.

Diagnosis.—? Anthracosironids with a pear shaped-opisthosoma, ca 1.3 times longer than wide, terminating in four prominent and slightly incurving spines.

Vratislavia silesiaca (Römer 1878)
Figs. 4, 5

Architarbus silesiacus Römer 1878:55.

Anthracomartus (*Architarbus*) *silesiacus* (Römer); Haase 1890: 650.

Vratislavia silesiaca (Römer); Frič 1904:44–45, pl. 13, figs. 5, 6, text-figs. 56A, B; Pocock 1911:7; Petrunkevitch 1913:97; Schwarzbach 1935:5, 6, fig. 5; Petrunkevitch 1953:89; Petrunkevitch 1955:109, fig. 74(3).

Material.—Poland: holotype, from the "Ferdinandgrube bei Glatz" (= Kłodzko), Lower Silesia, Sabarth, Pennsylvanian (Langsettian?), [originally in the Geological Institute, Breslau (= Wrocław), Nr. 557, now missing, presumed lost].

Description.—See Frič (1904), who provided the only relatively complete description, and mentioned a body length of 10 mm and a width of 4 mm.

Remarks.—In the absence of a type, it is tempting to treat *Vratislavia* as an incertae sedis taxon too. However, its opisthosomal proportions coupled with the reported terminal spination offer a diagnostic character combination which could potentially be recovered in future material. Whether it is an eophrynid, as assumed by Petrunkevitch, is debatable. Eophrynidae usually have a heavily ornamented body (Pocock 1902; Dunlop 1995; Garwood et al. 2009) and, like most trigonotarbids, a more rounded to oval opisthosoma, typically only marginally longer than wide.

The proportions of *V. silesiaca* are far more like another trigonotarbid family: Anthracosironidae (compare Figs. 4, 5 vs 6). Of particular note is a somewhat elongate, pear- to lozenge-shaped opisthosoma, noticeably longer than wide, with a bluntly rounded posterior end and strongly procurved opisthosomal segments around the anal operculum. The type genus, *Anthracosiro* Pocock 1903, was described in detail by Pocock (1903a, 1903b, 1911). As pointed out by Frič (1904), the original illustration of *Anthracosiro woodwardi* Pocock 1903 (see Pocock 1903a, fig. A, probably based on NHM 1551) hints at very small spines at the back of the opisthosoma in a similar position to those drawn for *V. silesiaca*. A detailed restudy of *Anthracosiro* is planned which should allow this spine character to be investigated further. It is not seen in other published illustrations. An early Devonian trigonotarbid from Wales, United Kingdom, has also been assigned to the Anthracosironidae by Dunlop & Selden (2004), but since it is mostly known in dorsal view, it offers few characters for direct comparison to the largely ventrally preserved *Vratislavia*. Overall, the habitus of *V. silesiaca* is much more consistent with an anthracosironid than an eophrynid. An unequivocal placement of incomplete and/or missing fossils will always be difficult. The presumption here is that the defensive marginal spination is adaptive, and thus prone to be a homoplastic character, and that spination (in isolation) is insufficient grounds to justify placement in Eophrynidae.

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LITERATURE CITED

Bossowski, A., A. Ihnatowicz, K. Mastalerz, L. Kurowski & G.J. Nowak. 1995. Intra-Sudetic Depression. Pp. 142–147. *In* The Carboniferous System of Poland. (A. Zdanowski & H. Zakova, eds.). Polish Geological Institute, Warszawa.

Cardwell, D.H., R.B. Erwin & H.P. Woodward. 1968 (slightly revised 1986). Geologic Map of West Virginia: Map 1, East Sheet, scale 1:250,000. West Virginia Geological and Economic Survey, Morgantown, West Virginia, USA.

Dunlop, J.A. 1995. A redescription of two eophrynids (Arachnida: Trigonotarbida) from the Coal Measures (Carboniferous) of Ostrava, Czech Republic. Neues Jahrbuch für Geologie und Paläontologie, Monatshefte 1995(8):449–461.

Dunlop, J.A. & R. Rößler. 2002. The trigonotarbid arachnid *Arthraconartus voelkelianus* (Anthracomartidae). Journal of Arachnology 30:211–218.

Dunlop, J.A. & P.A. Selden. 2004. A trigonotarbid from the Lower Devonian of Tredomen, Wales. Palaeontology 47:1469–1476.

Frič, A. 1904. *Palaeozoische Arachniden*. A. Frič, Prague.

Garwood, R., J.A. Dunlop & M.D. Sutton. 2009. High-fidelity X-ray micro-tomography reconstruction of siderite-hosted Carboniferous arachnids. Biology Letters 5:841–844.

Haase, E. 1890. Beitrag zur Kenntniss der fossilen Araehniden. Zeitschrift der Deutsche geologische Gesellschaft 1890:629–657.

Martino, R.L. 1996. Stratigraphy and depositional environments of the Kanawha Formation (Middle Pennsylvanian), southern West Virginia, USA. International Journal of Coal Geology 31:217–248.

Petrunkevitch, A.I. 1913. A monograph of the terrestrial Palaeozoic Arachnida of North America. Transactions of the Connecticut Academy of Arts and Sciences 18:1–137.

Petrunkevitch, A.I. 1949. A study of Palaeozoic Arachnida. Transactions of the Connecticut Academy of Arts and Sciences 37:69–315.

Petrunkevitch, A.I. 1953. Palaeozoic and Mesozoic Arachnida of Europe. Memoirs of the Geological Society of America 53:1–128.

Petrunkevitch, A.I. 1955. Arachnida. Pp. 42–162. *In* Treatise on Invertebrate Paleontology. Part P, Arthropoda 2. (R.C. Moore, ed.). Geological Society of America, Boulder, Colorado, and University of Kansas Press, Lawrence, Kansas.

Pocock, R.I. 1902. *Eophrynus* and allied Carboniferous Arachnida. Geological Magazine 4(9):439–448, 487–493.

Pocock, R.I. 1903a. A new Carboniferous arachnid. Geological Magazine 4(10):247–251.

Pocock, R.I. 1903b. Further remarks upon the Carboniferous arachnid *Anthracosiro*, with the description of a second species of the genus. Geological Magazine 4(10):405–408.

Pocock, R.I. 1910. Notes on the morphology and generic nomenclature of some Carboniferous Arachnida. Geological Magazine 5(7):505–512.

Pocock, R.I. 1911. A monograph of the terrestrial Carboniferous Arachnida of Great Britain. Monographs of the Palaeontographical Society 64:1–84.

Römer, F. 1878. Auffindung und Vorlegung eines neuen Gliderthieres in dem Steinkohlengebiete der Ferdinandgrube bei Glatz. Jahresbericht der Schlesischen Gesellschaft für Vaterländische-Kultur 56:54–55.

Rößler, R. & J.A. Dunlop. 1997. Redescription of the largest trigonotarbid arachnid – *Kreischeria wiedei* Geinitz 1882 from the Upper Carboniferous of Zwickau, Germany. Paläontologische Zeitschrift 71:237–245.

Schwarzbach, M. 1935. Spinnentiere (Arachnoidea) aus dem schlesischen Oberkarbon. Jahresberichten der Geologischen Vereinigung Oberschlesiens 1935:1–8.

Scudder, S.H. 1868. Supplement to descriptions of Articulates. Description of fossil insects found on Mazon Creek and near Morris, Grundy Co., Ill. Geological Survey of Illinois 3:566–572.

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